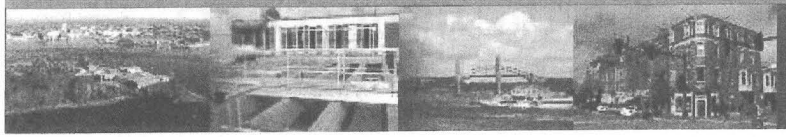
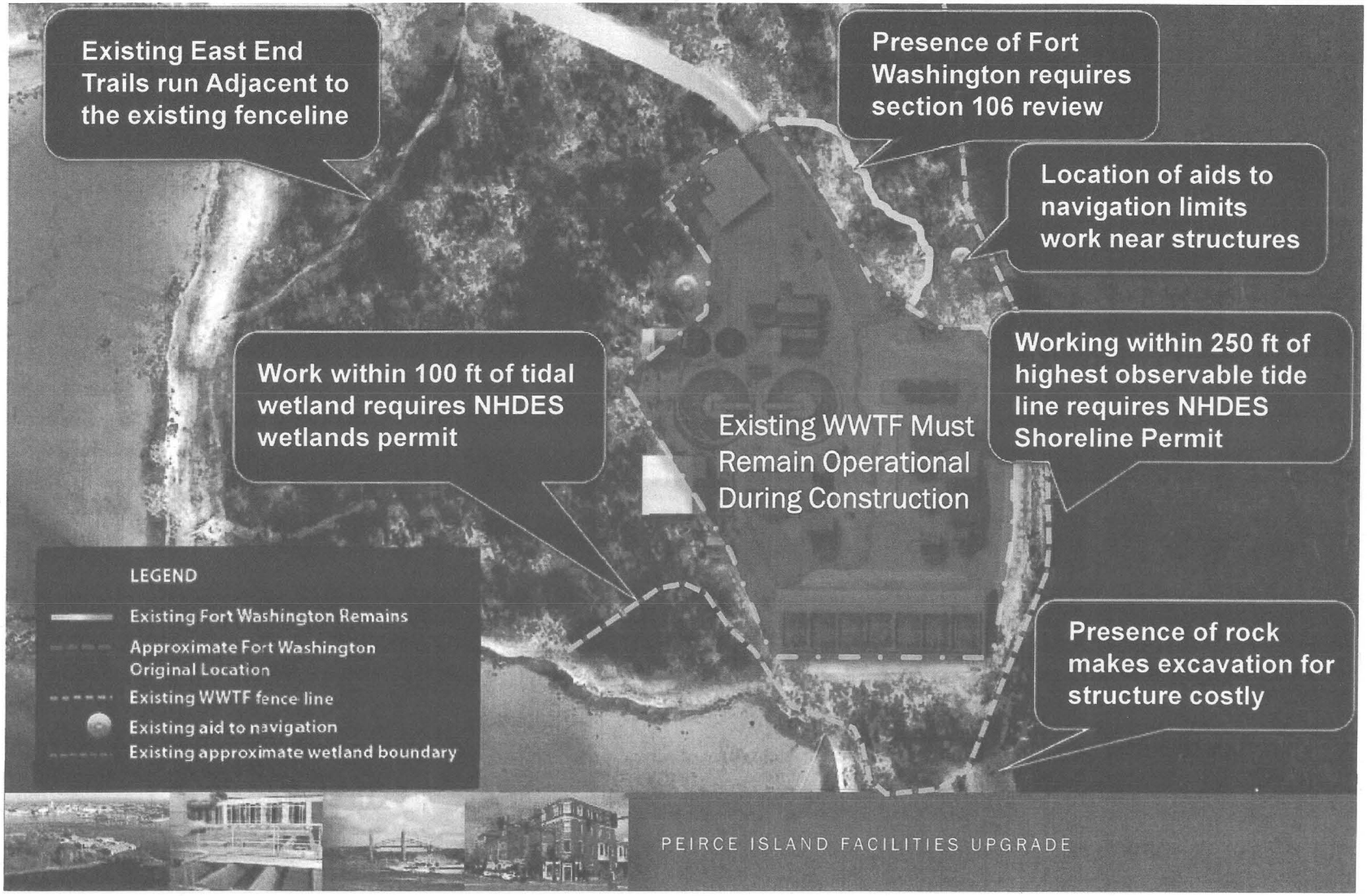
Pilot Study

- Upgrading PI WWTF While Staying Within Existing Fence-line Required Use of Small Footprint, High Rate Emerging Treatment Technologies

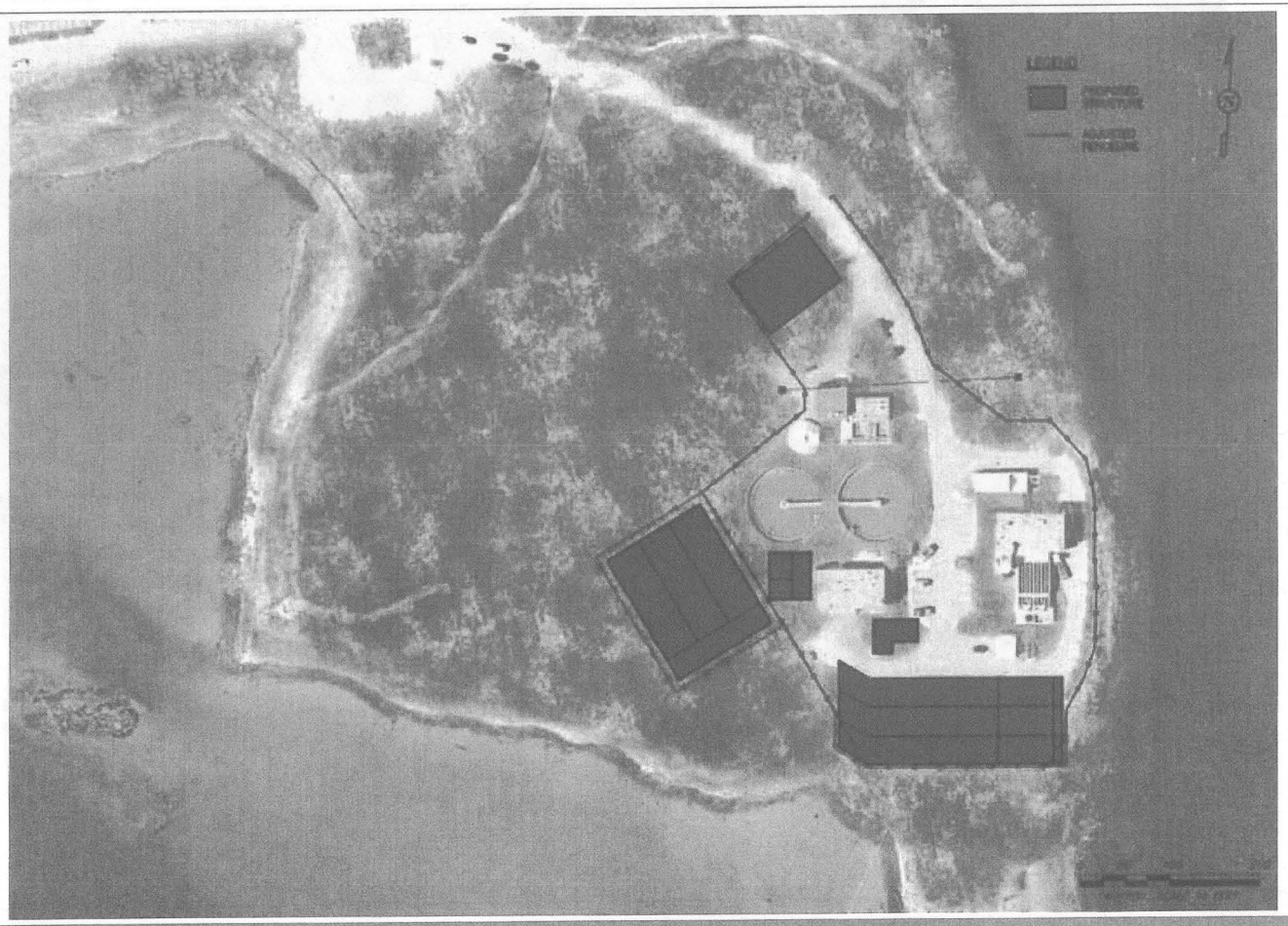
- Technologies Were Piloted to :
  - Define technology performance under varying flow and load conditions and assess capacity for each technology
  - Determine the ability to upgrade to meet future nutrient requirements
  - Identify operational and maintenance factors specific to each technology
  - Confirm Manufacturer/Vendor sizing criteria and space requirements to provide secondary treatment for each technology

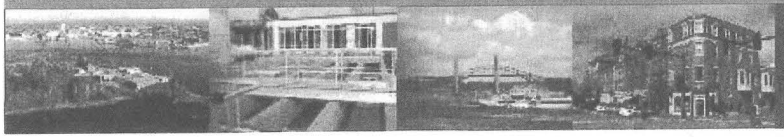


Site Constraints

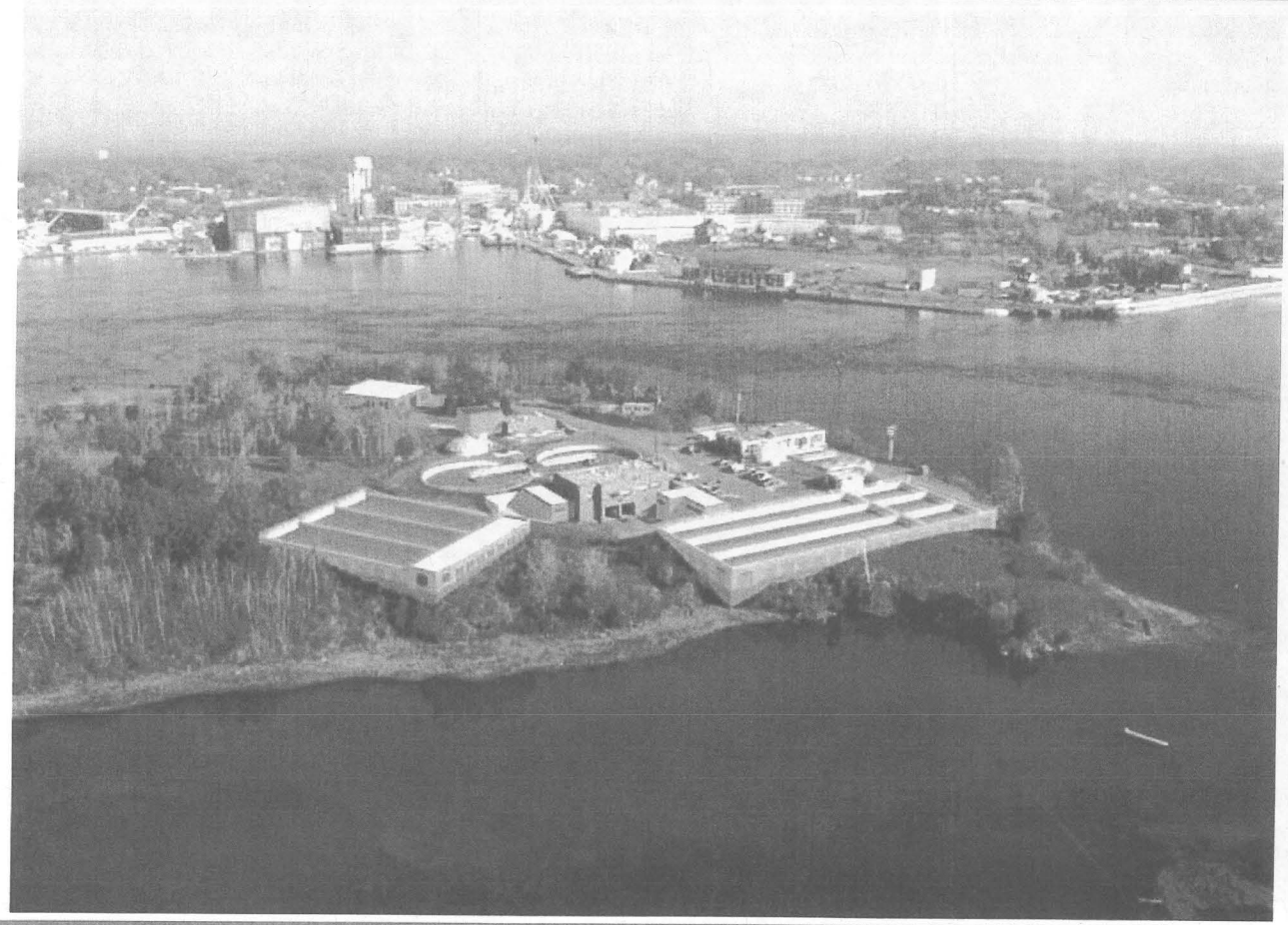


Conventional Activated Sludge - $57M



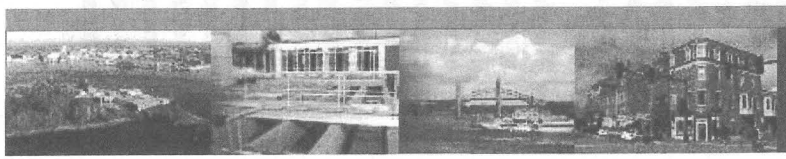


Conventional Activated Sludge Rendering



Advantages/Disadvantages

Process	Advantages	Disadvantages
Conventional Activated Sludge (CAS)	• Lowest Initial Capital Cost • Lowest O&M Cost • Commonly Used Technology • Not a Proprietary Process • Longer Operating History • Easier to Operate • Reduced Solids Handling Costs	• Larger Footprint – Outside Fence • Increased Potential for Site Permitting Challenges • Additional Capital Upgrade Needed to Achieve Lower Nitrogen Limits • Performance Deteriorates at Higher Flow
Biological Aerated Filter (BAF)	• Smaller Footprint – Inside Fence • No Additional Capital Cost Required to Achieve Lower Nitrogen Limits • Vendor Performance Guarantee • Robust Cold Weather Operation • Less Susceptible to High Flow Washout	• Higher Initial Capital Cost • Higher O&M Cost • Fewer Operating Installations (333 total world wide, 38 in North America) • More Mechanical Equipment • Proprietary Process



AECOM

AECOM
701 Edgewater Drive
Wakefield, MA 01880
www.aecom.com

781 246 5200 tel
781 245 6293 fax

J-60223731

April 30, 2013

Mr. Terry Desmarais, P.E.
City Engineer
Department of Public Works
680 Peverly Hill Road
Portsmouth, NH 03801

Subject: Peirce Island Wastewater Treatment Facility (WWTF) Upgrade
Consent Decree Compliance Schedule

Dear Mr. Desmarais:

As we have discussed, if the WWTF upgrade is to be revised to include nitrogen removal, we do not believe this can be accomplished within the current schedule in the Consent Decree without employing uncommon construction practices. This letter offers details on the major concerns that we have on the schedule.

When the Consent Decree compliance schedule was negotiated and agreed upon, the level of treatment to be achieved at the WWTF was the secondary treatment limits contained in the 2007 NPDES permit. The ability to remove nitrogen from the wastewater effluent was considered as a future step to be implemented at an undetermined time well after the upgraded WWTF was completed. Recent correspondence from EPA received by the City to date has indicated that a nitrogen limit will be included in the next permit cycle, but it has not firmly indicated what the proposed nitrogen limit will be. You have indicated that the design should be based on an assumed seasonal rolling average of 8 mg/L nitrogen.

The change from implementing nitrogen removal as a future process modification to one that is incorporated into the current WWTF upgrade design has a significant impact on the effort to upgrade the existing WWTF. A treatment facility capable of nitrogen removal takes more time to design and construct than a secondary facility. A nitrogen removal facility has more and larger components than a secondary process and this makes it harder to fit within the existing plant fence line, increases the amount of design work because the site is that much more confined, and lengthens the construction period because of the increased tank size and greater care that must be taken when working close to existing structures. This change will significantly increase the scope and cost of the project. The total project cost, which includes engineering and contingencies, would rise from the $30.5 million in the Final Wastewater Master Plan Supplement to $60.5 million, as a result of the inclusion of nitrogen removal. The estimated construction cost would rise over 100% from approximately $20 million to approximately $42 million. If this project were to be constructed with the current compliance schedule, it would require construction production rates that average nearly $2 million per month, with some months well in excess of $2 million per month, over the construction period. We do not believe this is achievable without employing uncommon construction practices. For comparison, typical water and wastewater treatment facility construction projects of this magnitude expend on the

order of $1 million per month. Table 1 identifies a number of recent projects and the cost expended per month.

Table 1. New England Water and Wastewater Treatment Facility Project Costs and Durations

Project	Construction Cost ($MM)	Duration (Months)	Construction Cost Per Month ($MM)
Manchester, CT	$44	42.5	$1.0
Meriden, CT	$35	25	$1.4
Jaffrey, NH	$13	22	$0.6
Cheshire, CT	$26	25	$1.0
Nashua, NH	$27	28	$1.0
Branford, CT	$22	24	$0.9
Westfield, MA	$18	21	$0.9
N. Attleborough, MA	$22	29	$0.8
Carroll WTP – Ware, MA	$30	30	$1.0

To meet the current compliance schedule with the $45 million construction cost, in which construction is to be completed by March 2017, it is likely that the construction contractor would need to employ on the order of 75 to 100 workers on-site at times. It is also likely that there would need to be multiple shifts at times, which is not a normal construction practice. This level of construction activity would result in numerous adverse impacts to the City which are discussed below:

- First, continuous construction with large numbers of construction workers on the small Peirce Island WWTF site raises both safety and quality control issues. Existing plant operations are likely to be compromised throughout the duration of construction due to the distractions and interruptions of the plant staff that reduces the amount of time they have to operate and maintain the existing facility. Lastly, attempting to increase the level of construction activity on-site and the speed at which work must be performed increases the chances of mistakes which may impact plant operations.

- Second, access to the plant site is through one road (Peirce Island Road) which is shared with the public pool, park, state fish pier, boat launch, and other public spaces. Equally concerning is that Peirce Island Road begins in the middle of the Strawbery Banke Museum, and is immediately adjacent to Prescott Park. Strawbery Banke is an outdoor history museum located in the City's South End historic district. It features more than 40 restored buildings built between the 17th and 19th centuries. Strawbery Banke is a heavily used tourist destination that attracted 77,000 visitors in 2012. Stretching along the Piscataqua River from lower State Street to Peirce Island Road, Prescott Park consists of over ten acres of flower gardens, walkways, seating, docking and grass areas all designed for public use and recreation. The Prescott Park Arts Festival presents numerous music, art, theater, and

dance events during the day and at night from June through September that attracted over 18,000 people in 2012.

- Third, there is limited parking on-site at the existing treatment facility. It is likely that during construction of the upgrade the contractor will need to bus workers in, which reduces the amount of time personnel can work per shift, slows the work and will result in the contractor bringing larger numbers of personnel to the job to make up for the lost time. There is an additional safety risk associated with having a large amount of construction traffic share a road that is frequently used by pedestrians.

- Fourth, access to the WWTF must go through downtown Portsmouth or adjacent residential neighborhoods. Multiple shift operations will result in an increase in truck traffic in these areas throughout the day and night. Although a mandatory construction traffic route will likely be required as part of construction, there is no way to access the site by road without traversing heavily developed residential or commercial areas.

- Fifth, the WWTF site has a limited area available for material storage and staging. This situation may require the contractor to have a remote staging area which would likely impact the rate of construction due to the need to bring materials and supplies in as-needed. Additionally, this situation would likely increase truck traffic because the contractor will only be able to bring small loads of construction material on-site and store it there until it is needed.

- Sixth, the speed at which the construction would have to take place would likely result in inefficiencies, which would likely result in added cost to the City. The contractor's ability to effectively manage the work would likely decrease due to the large numbers of multiple crews on-site and multiple deliveries that may be required to arrive daily.

- Finally, multiple shift construction by nature will cause noise and light impacts during the evening and night hours due to heavy equipment operation and illumination needed for work when daylight is not present. This will impact the residences nearby on Shapleigh Island as well as the residential areas in the South End of the City that overlook Peirce Island. It may also impact events at Prescott Park.

For all of the above reasons, we would not recommend multiple shifts as it would expose the City and its residents to risks associated with such activity.

A longer construction schedule is warranted for adding a nitrogen removal facility when compared to a secondary treatment facility due to the increased amount of site work and concrete that will be required with the larger project. Additional tank volume is required for nitrification and denitrification which increases the amount of excavation and concrete placement that must be completed before the project is finished. These activities are expected to require an extended period of construction due to the presence of extensive rock on Peirce Island, limitations on the size of a concrete pour, and the need for concrete to cure.

Once the project reaches substantial completion, startup of a nitrogen removal plant will also take longer than startup of a traditional secondary treatment plant. The startup of the nitrification and denitrification processes will be completed in two-steps because the denitrifying bacteria will not have a food source until the nitrification process is working. The bacteria required for nitrification grow and reproduce slowly which results in a longer time for them to take hold in the process in large enough numbers.

For these reasons, we suggest that the City discuss with EPA and NHDES granting an extension of the consent decree dates for both design and construction for a period of approximately 18 months.

As we have discussed, AECOM and the City will be collaborating to develop an overall project schedule for the upgrade that minimizes the extent of a schedule extension needed to complete the larger project. It may be possible within the construction contract to establish an interim milestone that would prioritize completion of the BAF, the selected technology, facilities ahead of upgrade work on the existing plant facilities. This approach would allow completion of the treatment process earlier than if there were only one completion date for the entire upgrade project. This and other potential schedule acceleration options will be assessed in the initial design phase of the project.

If you should have any questions, please feel free to contact us.

Very truly yours,

Jon R. Pearson, P.E.
Vice President
AECOM

JRP/enm

AECOM

AECOM
701 Edgewater Drive
Wakefield, MA 01880
www.aecom.com

781 246 5200 tel
781 245 6293 fax

J-60223731

July 26, 2013

Mr. Terry Desmarais, P.E.
City Engineer
Department of Public Works
680 Peverly Hill Road
Portsmouth, NH 03801

Subject: Peirce Island Wastewater Treatment Facility Upgrade
Consent Decree Schedule Extension

Dear Mr. Desmarais:

In response to your request, we have prepared a summary cost comparison of the estimated costs for upgrading the Peirce Island WWTF to provide secondary treatment versus the estimated costs for upgrading the WWTF to provide nitrogen removal to a seasonal rolling average of 8 mg/l total nitrogen. For this cost comparison, we have used the BAF secondary cost from the Phase 1 Piloting Evaluation versus the BAF nitrogen removal cost from the Phase 2 Initial Piloting Report. The cost comparison is presented in the following table:

Peirce Island WWTF Upgrade – Estimated Project Cost Comparison By Project Element

Project Component	Secondary Treatment	Total Nitrogen = 8 mg/L
Headworks	$5,000,000	$5,500,000
Existing Facility Upgrades	$8,000,000	$10,000,000
Secondary Pump Station	$4,000,000	$5,000,000
Filter Building Demolition	$3,000,000	$2,500,000
First Stage BAF	$11,000,000	$20,000,000
Second Stage BAF	-	$13,500,000
Sludge Storage / Sludge Thickening	$2,000,000	$3,000,000
Chemical Addition	-	$1,500,000
Main Electrical Service	-	$2,000,000
Total Estimated Project Cost	**$33,000,000**	**$63,000,000**

Please note that the cost presented for the BAF under the Total Nitrogen of 8 mg/l column represents the revised layout inside the WWTF fence and the cost for the Existing Facility Upgrades has been increased by $2 million from the cost in the Phase 2 Initial Piloting Report. As indicated in the table, there are significant additional facilities needed as part of an upgrade to achieve nitrogen removal that are not required to provide secondary treatment only. The attached figures further illustrate the differences between the two upgrade approaches.

We have also prepared the following bulleted list of reasons why an extension of the current Consent Decree schedule is warranted for construction of a nitrogen removal upgrade of the WWTF:

- The existing Consent Decree Schedule was first developed in November of 2010 for construction of only a secondary process upgrade. At that time, it was planned that the existing Filter Building would be modified to house the secondary treatment process, and the technology for the upgrade had not yet been selected. Following completion of the Phase 2 Initial Piloting in October 2012, the BAF technology was selected and it was recognized that the requirement for nitrogen removal to 8 mg/l was imminent. A nitrogen removal process upgrade will require complete demolition of the existing Filter Building to allow construction of the two stage BAF process.

- Additional BAF cell volume is required for nitrification and denitrification and this increases the amount of excavation and concrete placement.

- Additional solids handling capacity is needed for the additional sludge generated by the nitrogen removal process.

- A nitrogen removal upgrade will require more, and larger, components than only a secondary process upgrade. This will require more time and planning in the design phase to enable the project to fit within the existing plant fence line, and will lengthen the construction period because of the increase in BAF cell sizes and number. The larger project will increase the number of instances where work will be close to existing structures which will require greater care and time for construction.

- Startup will take longer because nitrogen removal requires cultivation of three types of organisms, rather than one for traditional secondary treatment.

- Construction of a nitrogen removal upgrade within the current Consent Decree schedule would require uncommon construction such as multiple shift construction in order to meet uncommonly high construction production rates. Multiple shift construction is not recommended for this site because it would expose the City and its residents to the following adverse impacts:

    - ✓ Multiple shift construction with large numbers of workers (approximately 75-100) raises both safety and quality control issues for both construction employees and WWTF personnel.

    - ✓ Access to the plant site is through one road which is shared with the public using the facilities at the pool, park, state fish pier, boat launch, hiking trails, and other public spaces which would be impacted by multiple shift construction.

    - ✓ Limited parking on-site may require contractor to bus workers in, which reduces the amount of time personnel can work per shift.

    - ✓ Access to the WWTF must go through downtown Portsmouth or adjacent residential neighborhoods. Multiple shift operations will result in an increase in truck traffic in these areas throughout the day and night with attendant noise and disruption of residents, tourists, and businesses.

- ✓ Limited area available for material storage and staging may require the contractor to use more remote staging areas which could negatively impact the rate of construction due to the need to bring materials and supplies in as-needed.
- ✓ Speed at which the construction would have to take place would likely result in inefficiencies, which would likely result in added cost to the City.
- ✓ Multiple shift construction will cause noise and light impacts during the evening and night hours.

For these reasons, in our opinion, an extension of the current Consent Decree schedule is warranted.

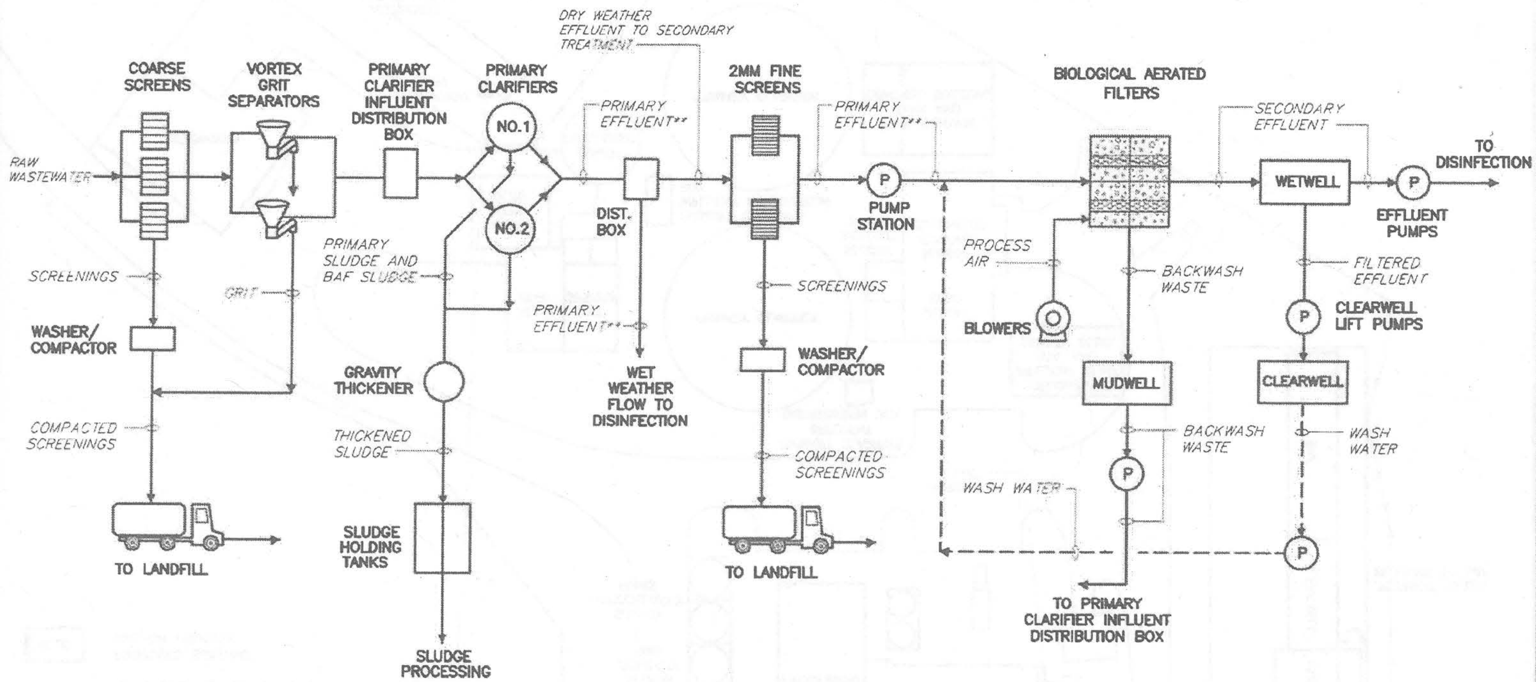
If you should have any questions concerning this information, please feel free to call.

Very truly yours,

Jon R. Pearson, P.E.
Vice President
AECOM

Encl.

JRP/enm



** DURING WET WEATHER EVENTS, CLARIFIERS MAY BE OPERATED IN CHEMICALLY ENHANCED MODE.

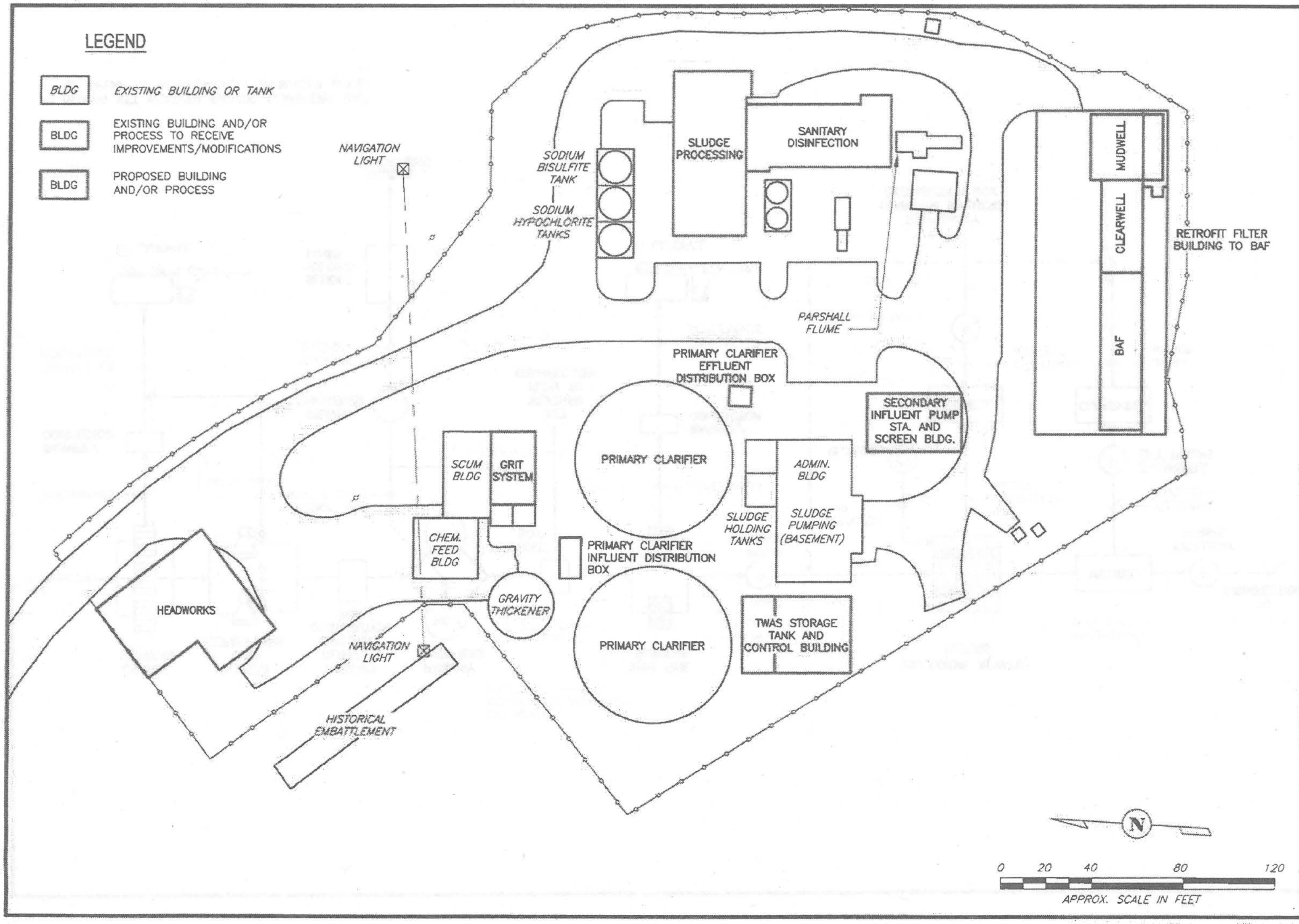
AECOM
701 Edgewater Drive
Wakefield, MA 01880
Ph. (781) 246-5200

WWMP PILOTING - PHASE 1 ENGINEERING EVALUATION
PEIRCE ISLAND WWTF - PORTSMOUTH, NH

BAF
CONVENTIONAL SECONDARY TREATMENT

OPTION 1
FIG. 1-CST-PFS

PROCESS FLOW SCHEMATIC



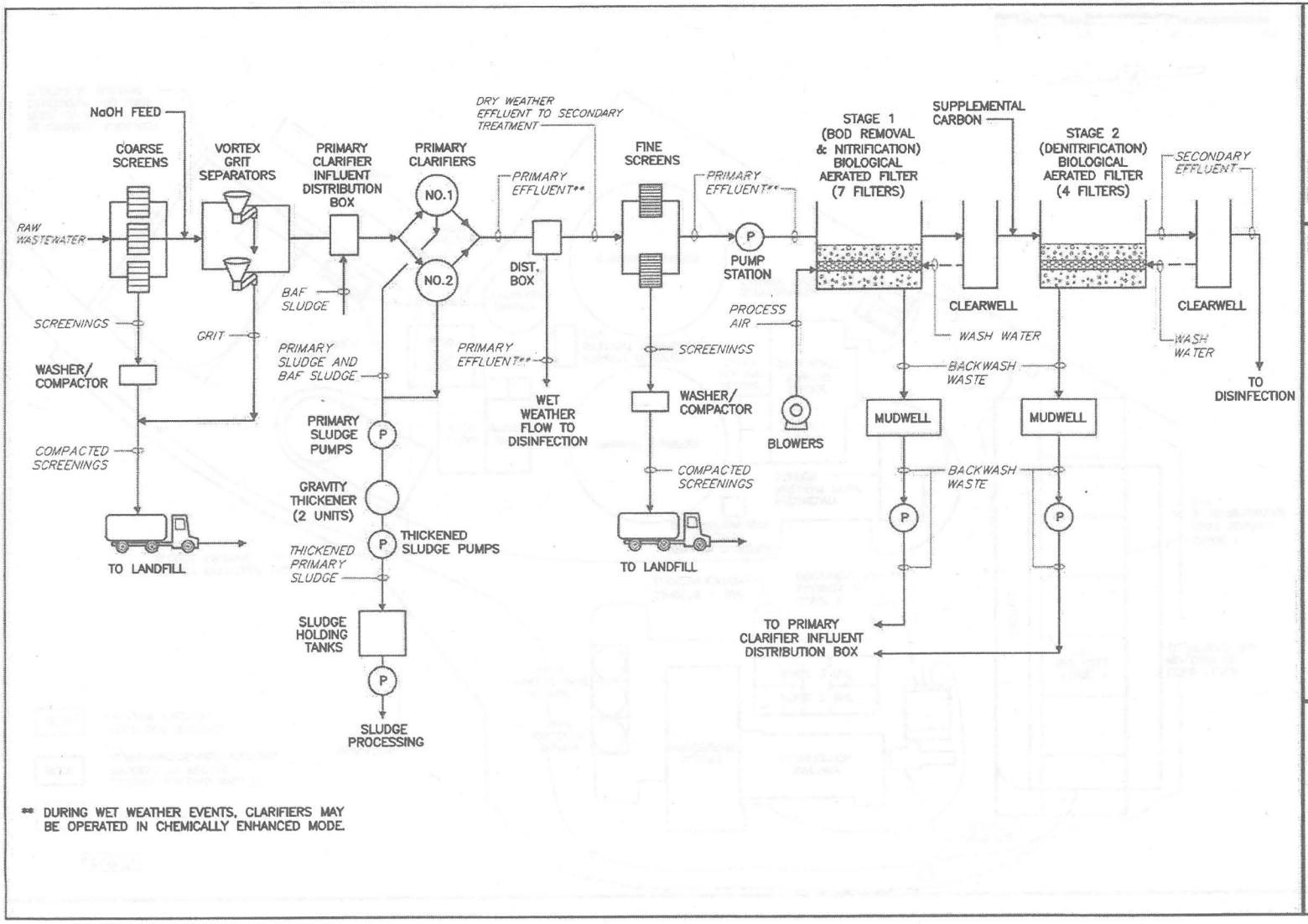
AECOM
701 Edgewater Drive
Wakefield, MA 01880
Ph. (781) 246-5200

WWMP PILOTING - PHASE 1 ENGINEERING EVALUATION
PEIRCE ISLAND WWTF - PORTSMOUTH, NH

BAF
CONVENTIONAL SECONDARY TREATMENT

OPTION 1
FIG. 1-CST-SL

SITE LAYOUT

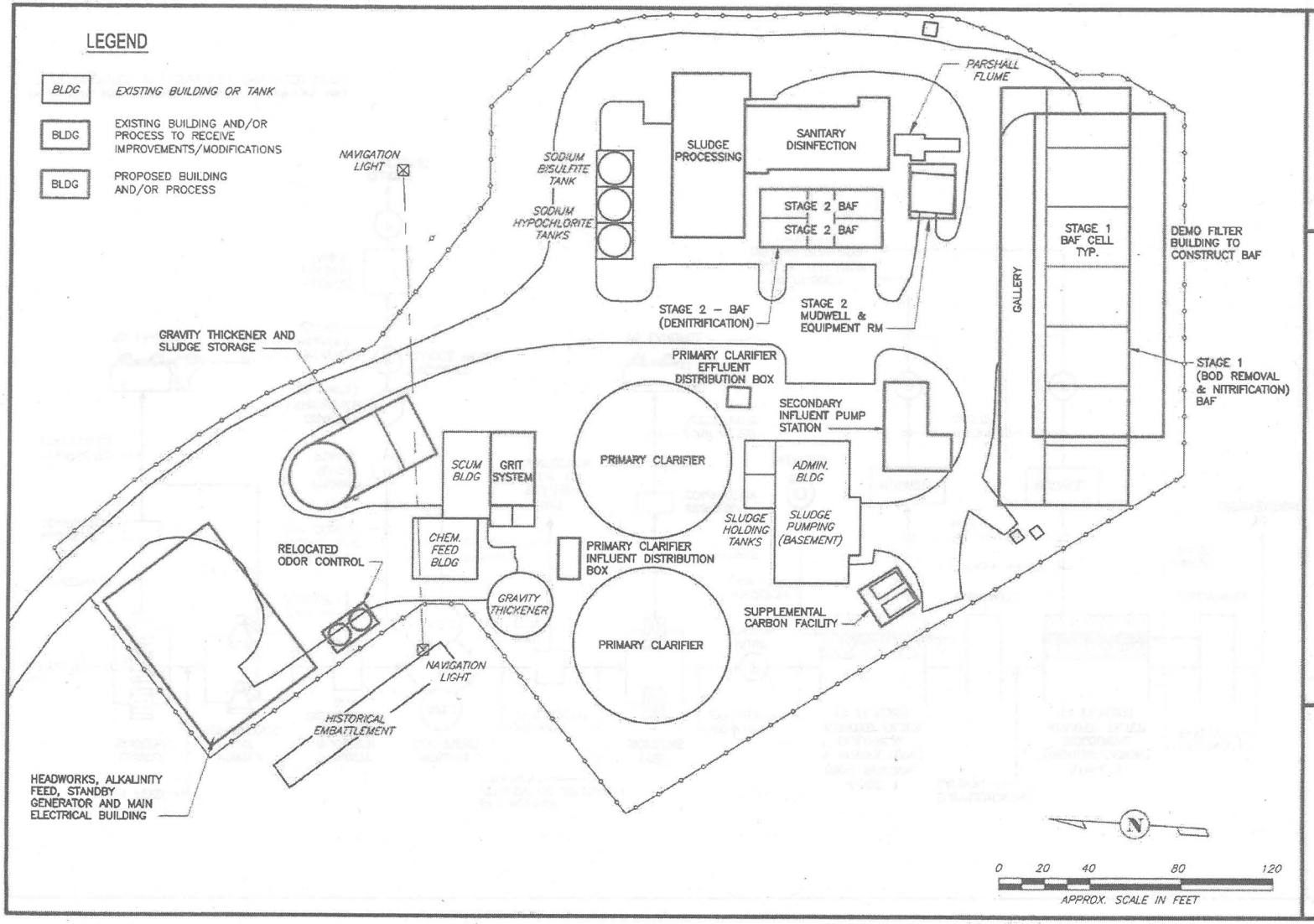


** DURING WET WEATHER EVENTS, CLARIFIERS MAY BE OPERATED IN CHEMICALLY ENHANCED MODE.

AECOM
701 Edgewater Drive
Wakefield, MA 01880
Ph. (781) 246-5200

WWMP PILOTING - PHASE 2 INITIAL PILOTING
PEIRCE ISLAND WWTF - PORTSMOUTH, NH
BAF
TOTAL NITROGEN < 8 mg/L

FIGURE 5-1
PROCESS FLOW SCHEMATIC



AECOM
701 Edgewater Drive
Wakefield, MA 01880
Ph. (781) 246-5200

PEIRCE ISLAND WWTF - PORTSMOUTH, NH
BAF
TOTAL NITROGEN < 8 mg/L

FIGURE 2
SITE LAYOUT

AECOM
701 Edgewater Drive
Wakefield, MA 01880
www.aecom.com

781.246.5200 tel
781.245.6293 fax

Memorandum

To	Terry Desmarais, City Engineer	Page 1 of 4
CC	Peter Rice, Director; Brian Goetz, Deputy Director; and Paula Anania, Chief Operator	
Subject	Peirce Island WWTF Upgrade Design Information Requested in Preparation for July 15 City Council Meeting	
From	Erik Meserve and Jon Pearson	
Date	July 12, 2013	

This memorandum provides responses and explanations to the information requested in preparation for the July 15th City Council Meeting. The items addressed are:

- The cost differential to build a secondary treatment facility followed by an upgrade for nitrogen removal to achieve 8 mg/l rather than build a nitrogen removal facility at the outset.
- The amount of additional time needed to construct a secondary facility followed by an upgrade for nitrogen removal to achieve 8 mg/l compared to building a nitrogen removal facility at the outset.
- The number of shifts and days per week required for construction of a nitrogen removal facility within the current Consent Decree Deadline
- Whether a BAF for secondary treatment only can fit inside the existing Filter Building
- The environmental benefit in terms of pounds per year discharged of upgrading the WWTF to achieve secondary treatment and nitrogen removal at the outset as opposed to constructing a secondary treatment upgrade followed by a separate nitrogen removal upgrade.

1.0 COST DIFFERENTIAL

AECOM was requested to provide an estimate of the cost differential to build a secondary treatment facility and then build an upgrade capable of achieving an effluent total nitrogen of 8 mg/L as a second construction project. This estimate should be based on the presumption that the City would dispute the 8 mg/L total nitrogen requirement from EPA and simply build a secondary treatment facility in compliance with the Consent Decree requirements.

Appendix A presents the cost estimates for the proposed secondary treatment BAF followed by upgrades necessary for nitrogen removal, including a denitrification BAF. The total estimated capital cost of these two projects is $67M which is $6M greater than the current estimate to construct both secondary treatment and nitrogen removal upgrades at the same time.

The secondary treatment upgrade would include the upgrades to the existing facilities, secondary influent pump station, first stage BAF and associated components, a gravity thickener sized for the additional secondary sludge only, additional sludge storage, and plant-wide electrical upgrades. Although only five of the six first stage BAF cells needed for secondary treatment and nitrification are necessary for secondary treatment, it has been assumed that all six cells would be constructed under this scenario.

The nitrogen removal upgrade would include the second stage BAF and associated components, an additional gravity thickener, relocation of the odor control unit, alkalinity storage and feed system in support of nitrification, and supplemental carbon storage and feed system in support of denitrification.

In developing this estimate the costs for the nitrogen removal upgrade are based on the schedule discussed below, and the costs have been escalated to reflect that the nitrogen removal upgrade would not be constructed until the year 2021/2022.

2.0 ADDITIONAL TIME NEEDED

AECOM was asked to provide an estimate of the amount of time saved in producing an effluent total nitrogen accomplished by completing a nitrogen removal facility together with secondary treatment rather than upgrading for nitrogen removal at a later date.

The schedule presented in Appendix B shows that an additional 4.25 years are needed to construct the nitrogen removal upgrades in two steps and achieve compliance when compared to the currently proposed schedule for a combined secondary and nitrogen removal facility. This schedule assumes that the City receives a new, final NPDES permit in January 2014 with only secondary treatment permit limits. Assuming a five year permit cycle before the effluent total nitrogen of 8 mg/l is imposed, during which time the City would dispute the nitrogen requirement as noted in Section 1, the next permit the City receives would be finalized in approximately June 2019. Design would commence shortly thereafter, followed by construction.

3.0 IMPACT OF COMPRESSED CONSTRUCTION PERIOD

The question that was raised was if the City had to construct the proposed TN8 facility (with an approximate construction cost of $45 million) in the current Consent Decree deadlines (24 month construction period) how many shifts or hours would the contractor have to work each a day and would it require more than 5 days a week?

To address this question AECOM consulted with our subcontractor, Carlin Contracting, who specializes in construction of water and wastewater facilities. We have concluded that if the current Consent Decree schedule has to be met, and the City chooses to construct a nitrogen removal facility within the allotted time, this will require the construction contractor's workforce to work more than the standard forty hour work week of eight hours per day, five days per week for a significant portion of the construction period. Every contractor approaches a project differently and since the approach to sequencing and scheduling the work is not dictated by the design engineer, we cannot define with certainty the approach that will be selected. Nonetheless, AECOM has attempted to estimate some of the major impacts such as number of working shifts per day and number of work days per week required.

As we have reviewed and discussed potential options that could be used to complete the project within 24 months, two options could be employed and are described below.

Option 1 – Single Shift with Extended Work Hours. Under this option, the work would be completed with a single shift of onsite workforce. It would be expected that for the majority of the 24 month construction period work would be conducted 6 days a week, with 10 hour work days. The first couple of months of work on the project would likely start with a more traditional 40 hour week as the contractor mobilized and initiated work. After several months, once construction was fully underway, the extended work day and work week schedule would occur, and continue for approximately 18-20 months. As the project neared completion, we would expect that the need for the extended work hours may be curtailed and return to a more traditional 40 hour work week.

Option 2 – Double Shift with Extended Work Hours. Under this option, the work would be completed with two shifts of onsite workforce, with each shift working an 8 hour day. As with Option 1, at first the project would likely start with a more traditional 40 hour work week as the contractor mobilized and

initiated work. As the work proceeded, a second shift would be brought on. The first shift would typically work from 7 am to 3:30 pm, and the second shift would start at 3 pm to provide an overlap with the first shift and continue until 11:30 pm. We would expect that the second shift may be needed for as much as half of the 24 month period, with a return to a single shift operation as the project neared completion. Since heavy construction (pipe installation, concrete placement, etc.) would occur during the second shift, major materials suppliers such as concrete would also need to work during the second shift. There would also likely be the need for some work on Saturdays under this option.

It is important to recognize that under either option to meet the 24 month schedule, there would an increase in the project cost associated with completing the work within a compressed time frame. With either option, there is a loss of production efficiency of the workforce when work is conducted outside the normal work week. There is typically a premium on the unit price to obtain concrete and other materials outside of normal working hours. In addition, with a second shift, union and other labor agreements often require a shift differential in worker pay rates. This loss of efficiency and other costs could increase project costs on the order of 8 to 12 percent or more.

4.0 SECONDARY BAF SIZE

AECOM was asked to review that if the Stage 1 BAF were to only provide secondary treatment without nitrification, whether it would fit within the existing Filter Building.

The total filter area proposed by Kruger for carbon removal and nitrification is 7,608 ft^2, spread over six identical filters. In this instance, achieving secondary treatment requires only 70-80% of the proposed filter area, or five filters as opposed to six. AECOM attempted to locate these cells within the footprint of the existing Filter Building but was not able to without encountering a fatal flaw. In every potential layout, a critical piece of the process was not able to be fit into the existing footprint.

Although the BAF previously fit inside the Filter Building during the Phase 1 evaluation, the increase in the design flows and loads as well as the consideration of BAF backwash has increased the area required beyond the confines of the existing Filter Building.

5.0 ENVIRONMENTAL BENEFIT

AECOM was requested to estimate the environmental benefit, measured in pounds of total nitrogen, of upgrading the WWTF to achieve secondary treatment and nitrogen removal at the outset as opposed to constructing a secondary treatment upgrade followed by a separate nitrogen removal upgrade.

To prepare this estimate, AECOM used historical flow data from January 2008 through June 2012. Future flow increases were not taken into account in light of the near term period of the analysis. The estimated annual mass of total nitrogen discharged to the environment was estimated for the current CEPT treatment process based on historical data over the same time period which shows an effluent total nitrogen concentration of approximately 24 mg/L. For a secondary effluent, there will be some reduction in total nitrogen due to biological uptake, and an effluent total nitrogen concentration of approximately 17 mg/l was estimated to account for this. For the nitrogen removal process, a seasonal rolling average effluent nitrogen concentration of 7 mg/L was used for April through October, and an effluent total nitrogen concentration of 12 mg/L was used for November through March. The 12 mg/L reflects operating the denitrification BAF in a maintenance mode during the November through April period. The table below displays these estimates.

Table 1. Estimated Annual Mass of Total Nitrogen Discharged

Process Configuration	TN (lb/yr)
CEPT Effluent	410,000
Secondary Treatment	300,000
Nitrogen Removal (to 8 mg/L)	160,000

Using these estimates, a comparison of constructing secondary treatment followed by a separate nitrogen removal upgrade or constructing secondary treatment and nitrogen removal together was

completed. In the schedule presented in Section 2.0 above, startup of the nitrogen removal facilities under the scenario with separate projects is completed by January 31, 2023. Using January 1, 2014 as the start date for this analysis and January 31, 2023 as the end date, the estimated environmental benefit has been completed and is presented below in Table 2.

Table 2. Estimated Environmental Benefit of Combining Secondary Treatment and Nitrogen Removal Projects

Implementation Approach	TN (lb)
Combined Projects	2,660,000
Separate Projects	3,090,000

As indicated in Table 2, by building the Peirce Island WWTF Upgrade as a combined secondary and nitrogen removal facility, the total pounds of nitrogen discharged would be reduced by nearly 15 percent over this time period when compared to implementing the plant upgrade in two separate projects.

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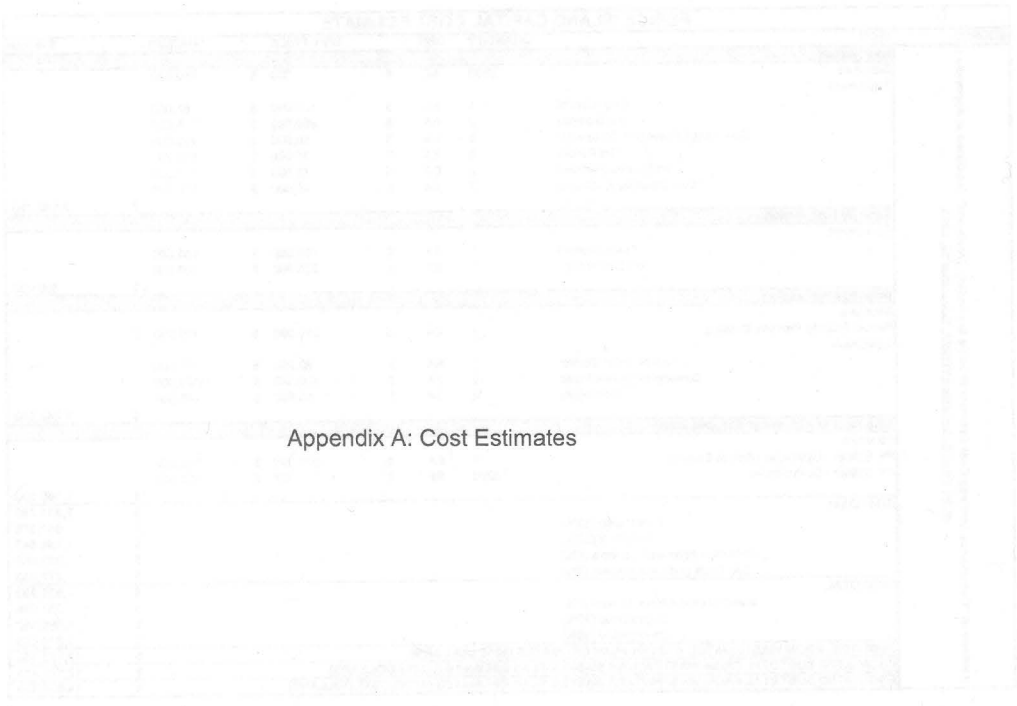


Appendix A: Cost Estimates

Opinion of Cost - BAF with Coagulant Dosing - No CEPT
Secondary Treatment Only at Peirce Island Site (6.13 MGD)

PEIRCE ISLAND CAPITAL COST ESTIMATE

SOURCE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	Subtotal
Portions of "Compliance Strategy Cost Estimate Biomag Secondary Treatment" contained in Appendix D of the Final Submission WWMP, November 15, 2010	**Headworks**					
	Structure	2500	SF	$ 300	$ 750,000	
	Equipment:					
	Odor Control	1	EA	$ 60,000	$ 87,000	
	Bar Screens	2	EA	$ 250,000	$ 725,000	
	Screenings Washer & Compactor	2	EA	$ 50,000	$ 145,000	
	Grit Pumps	3	EA	$ 35,000	$ 152,250	
	Vortex Grit Removal	2	EA	$ 75,000	$ 217,500	
	Grit Classifier & Washer	2	EA	$ 40,000	$ 116,000	
						$ 2,192,750
	Sanitary Disinfection					
	Equipment:					
	Pump System	1	EA	$ 100,000	$ 100,000	
	UV Disinfection	1	EA	$ 200,000	$ 200,000	
						$ 300,000
	Biosolids Processing					
	Structure					
	Rehab Existing Process Building	1	EA	$ 350,000	$ 350,000	
	Equipment:					
	Carbon Odor Control	1	EA	$ 60,000	$ 87,000	
	Dewatering Screw Press	2	EA	$ 400,000	$ 1,160,000	
	Conveyors	2	EA	$ 50,000	$ 145,000	
						$ 1,742,000
	Additional Structures and Modifications					
	Structure					
	PE Splitter - Upstream - Rehab Existing	1	EA	$ 500,000	$ 500,000	
	PE Splitter - Downstream	2200	SF	$ 300	$ 660,000	
						$ 1,160,000
	SUBTOTAL					**$ 5,394,750**
	Yard Piping (12%)					$ 647,370
	Electrical (22%)					$ 1,186,845
	Instrumentation and Controls (6%)					$ 323,685
	Site Work and Landscaping (7%)					$ 377,633
	SUBTOTAL					**$ 7,930,283**
	Island Construction Premium (3%)					$ 237,908
	Engineering (20%)					$ 1,586,057
	Contingency (30%)					$ 2,379,085
	SUBTOTAL FROM WASTEWATER MASTER PLAN ESTIMATES (2010 DOLLARS)					**$ 12,133,332**
	ESCALATED SUBTOTAL FROM WASTEWATER MASTER PLAN ESTIMATES (2012 DOLLARS)					**$ 12,981,436**
	ESCALATED SUBTOTAL FROM WASTEWTAER MASTER PLAN ESTIMATES (APRIL 2016 DOLLARS)					**$ 14,026,850**

PEIRCE ISLAND CAPITAL COST ESTIMATE

SOURCE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	Subtotal
AECOM WWMP Pilot - Post Phase 2 Initial Piloting, June 2013	**Secondary Pump Station (Fine Screens and Lift Station)**					
	Site Work and Landscaping	1	LS	$ 391,000	$ 391,000	
	Structure	1	LS	$ 774,000	$ 774,000	
	Process Piping and Appurtenances	1	LS	$ 332,000	$ 332,000	
	Equipment:					
	Odor Control	1	EA	$ 132,000	$ 132,000	
	Fine Screens, Washer and Compactor and Container	2	EA	$ 458,500	$ 917,000	
	Secondary Influent Pumps	3	EA	$ 97,667	$ 293,000	
	HVAC/Plumbing	1	LS	$ 26,000	$ 26,000	
	Instrumentation and Controls	1	LS	$ 113,000	$ 113,000	
	Electrical	1	LS	$ 162,000	$ 162,000	
						$ 3,140,000
	Demolish Filter Building including Main Electrical Facilities					
	Demolition	1	LS	$ 1,392,000	$ 1,392,000	
	Site Work and Landscaping	1	LS	$ 201,000	$ 201,000	
						$ 1,593,000
	Ferric and Polymer Addition					
	Process Piping and Appurtenances	1	LS	$ 106,000	$ 106,000	
						$ 106,000
	1st Stage BAF and Mudwell					
	Site Work and Landscaping	1	LS	$ 723,000	$ 723,000	
	Yard Piping	1	LS	$ 350,000	$ 350,000	
	Structure	1	LS	$ 4,478,000	$ 4,478,000	
	Process Piping and Appurtenances	1	LS	$ 1,173,000	$ 1,173,000	
	Equipment:					
	BAF Vendor (Kruger)	1	LS	$ 7,223,000	$ 7,223,000	
	HVAC/Plumbing	1	LS	$ 169,000	$ 169,000	
	Instrumentation and Controls	1	LS	$ 254,000	$ 254,000	
	Electrical	1	LS	$ 593,000	$ 593,000	
						$ 14,963,000
	Gravity Thickener, Sludge Storage Tank and Control Building					
	Site Work and Landscaping	1	LS	$ 225,000	$ 225,000	
	Structure	1	LS	$ 965,000	$ 965,000	
	Process Piping and Appurtenances	1	LS	$ 92,000	$ 92,000	
	Equipment:				$ -	
	Thickened Sludge Transfer Pumps	2	EA	$ 47,500	$ 95,000	
	Gravity Thickener Mechanism	1	EA	$ 142,000	$ 142,000	
	Dewatering Feed Pumps	2	EA	$ 20,500	$ 41,000	
	Grinders	2	EA	$ 41,500	$ 83,000	
	Sludge Mix Blowers	2	EA	$ 68,500	$ 137,000	
	Aeration Diffusers	1	LS	$ 77,000	$ 77,000	
	Odor Control	1	LS	$ 142,000	$ 142,000	
	HVAC/Plumbing	1	LS	$ 24,000	$ 24,000	
	Instrumentation and Controls	1	LS	$ 54,000	$ 54,000	
	Electrical	1	LS	$ 123,000	$ 123,000	
						$ 2,200,000
	Main Electrical Building and Standby Generator					
	Demolition	1	LS	$ 5,000	$ 5,000	
	Site Work and Landscaping	1	LS	$ 21,000	$ 21,000	
	Electrical Conduit	1	LS	$ 219,000	$ 219,000	
	Structure	1	LS	$ 171,000	$ 171,000	
	Equipment:					
	Electrical (Switchboard, MCB, ATS)	1	EA	$ 190,000	$ 190,000	
	Standby Generator	1	EA	$ 684,000	$ 684,000	
						$ 1,290,000
	SUBTOTAL					**$ 23,292,000**
	Island Construction Premium (3%)					$ 698,760
	Engineering and Contingency (40%)					$ 9,316,800
	SUBTOTAL FROM AECOM (2012 DOLLARS)					**$ 33,307,560**
	ESCALATED SUBTOTAL FROM AECOM (APRIL 2016 DOLLARS)					**$ 35,990,000**

OPINION OF CONSTRUCTION COST	$ 50,016,850
OPINION OF PROJECT COST (Rounded)	**$ 50,500,000**

Opinion of Cost - BAF with Coagulant Dosing - No CEPT
TN<8 mg/L at Peirce Island Site (6.13 MGD)

PEIRCE ISLAND CAPITAL COST ESTIMATE

SOURCE	ITEM	QUANTITY	UNIT		UNIT PRICE	AMOUNT	Subtotal
AECOM WWMP Pilot - Post Phase 2 Initial Piloting, June 2013	**2nd Stage BAF, Mudwell and Control Building**						
	Demolition	1	LS	10050	$ 10,000	$ 10,000	
	Site Work and Landscaping	1	LS	750874	$ 751,000	$ 751,000	
	Yard Piping	1	LS	237782	$ 238,000	$ 238,000	
	Structure	1	LS	2673564	$ 2,674,000	$ 2,674,000	
	Process Piping and Appurtenances	1	LS	216286	$ 216,000	$ 216,000	
	Equipment:						
	BAF Vendor (Kruger)	1	LS	2713456	$ 2,713,000	$ 2,713,000	
	HVAC/Plumbing	1	LS	70154	$ 70,000	$ 70,000	
	Instrumentation and Controls	1	LS	105232	$ 105,000	$ 105,000	
	Electrical	1	LS	245541	$ 246,000	$ 246,000	
							$ 7,023,000
	Gravity Thickener and Control Building						
	Site Work and Landscaping	1	LS	133662	$ 134,000	$ 134,000	
	Structure	1	LS	354317	$ 354,000	$ 354,000	
	Process Piping and Appurtenances	1	LS	72788	$ 73,000	$ 73,000	
	Equipment:					$ -	
	Thickened Sludge Transfer Pumps	2	EA	77206	$ 38,500	$ 77,000	
	Gravity Thickener Mechanism	1	EA	119790	$ 120,000	$ 120,000	
	Odor Control	1	LS	159607	$ 160,000	$ 160,000	
	HVAC/Plumbing	1	LS	12882	$ 13,000	$ 13,000	
	Instrumentation and Controls	1	LS	27452	$ 27,000	$ 27,000	
	Electrical	1	LS	64539	$ 65,000	$ 65,000	
							$ 1,023,000
	Relocate Odor Control Unit						
	Demolition	1	LS	29646	$ 30,000	$ 30,000	
	Site Work and Landscaping	1	LS	64213	$ 64,000	$ 64,000	
							$ 94,000
	Alkalinity Feed						
	Site Work and Landscaping	1	LS	7562	$ 8,000	$ 8,000	
	Structure	1	LS	175714	$ 176,000	$ 176,000	
	Process Piping and Appurtenances	1	LS	25420	$ 25,000	$ 25,000	
	Equipment:						
	Hose Pumps	2	EA	30903	$ 15,500	$ 31,000	
	Vertical Tanks	2	EA	30903	$ 15,500	$ 31,000	
	HVAC/Plumbing	1	LS	14142	$ 14,000	$ 14,000	
	Instrumentation and Controls	1	LS	20046	$ 20,000	$ 20,000	
	Electrical	1	LS	26268	$ 26,000	$ 26,000	
							$ 331,000
	Supplemental Carbon Addition						
	Site Work and Landscaping	1	LS	7465	$ 7,000	$ 7,000	
	Structure	1	LS	62494	$ 62,000	$ 62,000	
	Process Piping and Appurtenances	1	LS	70714	$ 71,000	$ 71,000	
	Equipment:						
	Storage Tanks	1	LS	88129	$ 88,000	$ 88,000	
	Metering Pumps	3	EA	39415	$ 13,000	$ 39,000	
	Instrumentation and Controls	1	LS	41393	$ 41,000	$ 41,000	
	Electrical	1	LS	56618	$ 57,000	$ 57,000	
							$ 365,000
	SUBTOTAL						**$ 8,836,000**
	Island Construction Premium (3%)						$ 265,080
	Add'l Cost for Splitting Project into Two Contracts (10%)						$ 883,600
	Engineering and Contingency (40%)						$ 3,534,400
	SUBTOTAL FROM AECOM (2012 DOLLARS)						**$ 13,519,080**
	ESCALATED SUBTOTAL FROM AECOM (JANUARY 2022 DOLLARS)						**$ 16,398,000**

OPINION OF CONSTRUCTION COST	**$ 16,398,000**
OPINION OF PROJECT COST (Rounded)	**$ 16,500,000**

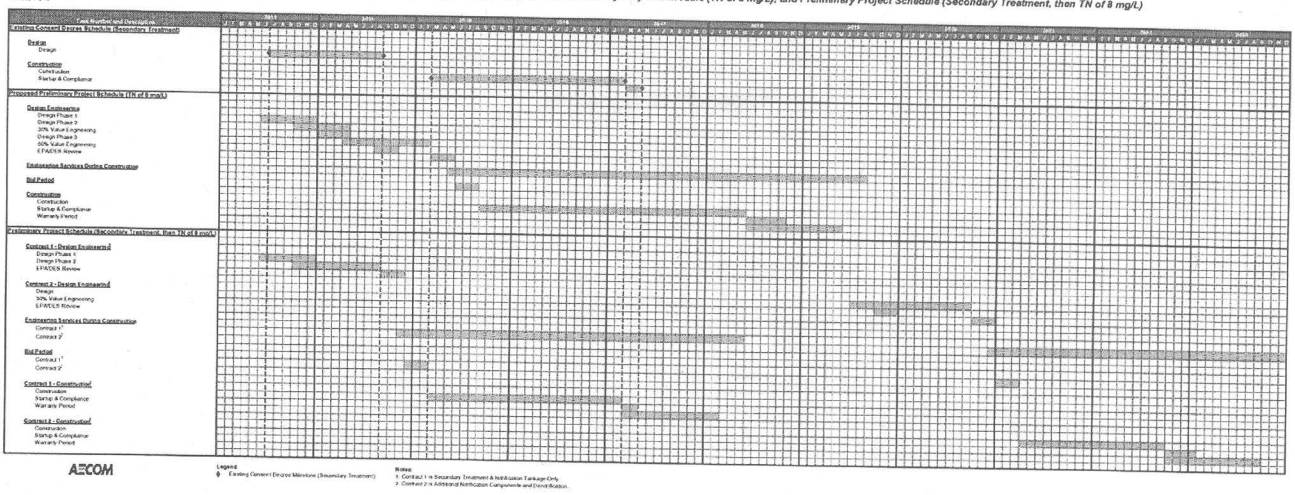
AECOM

Appendix B: Schedule

City of Portsmouth, New Hampshire
Peirce Island Wastewater Treatment Plant Design & Construction Schedule

Revised 7.8.13

Comparison of Existing Consent Decree Schedule (Secondary Treatment), Proposed Preliminary Project Schedule (TN of 8 mg/L), and Preliminary Project Schedule (Secondary Treatment, then TN of 8 mg/L)



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Legend
◆ Existing Consent Decree Milestone (Secondary Treatment)

Notes:
1. Contract 1 = Secondary Treatment & Nitrification Tankage Only
2. Contract 2 = Additional Nitrification Components and Denitrification